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(21)Application number : 11-191314 (71)Applicant : CIMEO PRECISION CO LTD

CITIZEN WATCH CO LTD

(22)Date of filing : 06.07.1999 (72)Inventor : MIZUMA ISAO

SHIMADA TAKASHI

SHIBA KAZUO

KANAZAWA TOYOJI

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(54) DYNAMIC PRESSURE BEARING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a means to improve precision of a clearance of a thrust bearing part of a dynamic pressure bearing device in mass production.

SOLUTION: In a dynamic pressure bearing device, it is made possible to control clearance precision in mass production by using a thrust spacer 30 free to carry out finishing work such as grinding work and polishing work, by controlling a clearance of a thrust bearing part as well as to carry out finishing work such as grinding work, polishing work of a bearing sleeve 10 relative to a thrust bearing surface by eliminating a stepped structure provided on a conventional bearing sleeve.

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2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] Fix to the inner circumference of housing the bearing sleeve which has the cylinder-like inner circumference section, and the axis which has the cylindrical periphery section is fitted into the inner circumference of this bearing sleeve, enabling a free revolution. Or fix to housing the axis which has the cylinder-like periphery section, and the bearing sleeve which has the cylindrical inner circumference section is fitted into the periphery of this axis, enabling a free revolution. Hydrodynamic bearing equipment characterized by fitting said thrust plate into opposite through a thrust spacer with said bearing sleeve and thrust supporting plate in the hydrodynamic bearing equipment which comes to prepare the thrust plate of the outer diameter which consists of a path of the periphery section of an axis size to these some axes.

[Claim 2] Hydrodynamic bearing equipment according to claim 1 characterized by using the ceramics for said thrust spacer.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the hydrodynamic bearing equipment used for the bearing of the revolution sections, such as a hard disk drive and a polygon mirror.

[0002]

[Description of the Prior Art] In the field of the spindle motor used for a hard disk drive, a polygon mirror, etc., from the demand of a high speed and high-capacity-izing, the spindle motor of high degree of accuracy is needed at high speed, and the spindle motor which adopted hydrodynamic bearing structure in connection with this is proposed variously. Also in it, one thrust plate is formed in an axis, one side of the bearing sleeve which counters an axis and an axis is fixed, the type which enabled the revolution of one side is comparatively easy structure, and since the miniaturization is easy, various advanced types are proposed. There are many types of the structure of preparing an opposed face with a thrust plate, also constituting bearing of the thrust direction from such a type while a bearing sleeve forms bearing of an axis and a radial direction so that it may state below, and managing the clearance between thrust plates further.

[0003] In JP,9-182367,A, a bearing sleeve has the field which counters a thrust

plate, forms the thrust bearing section, and has the structure of having the level difference which manages the clearance between the thrust bearing sections further at the same time it forms bearing of an axis and a radial direction. Moreover, a bearing sleeve is fixed to a pedestal and it is considering as the structure where an axis can be rotated freely. In addition, in JP,9-298860,A, it is the structure of having the level difference which manages the clearance between radial bearing, the thrust bearing section, and the thrust bearing section, and a bearing sleeve fixes an axis and is considering as the structure where a bearing sleeve can be rotated freely.

[0004] Drawing 4 is the sectional view showing the motor 150 incorporating conventional hydrodynamic bearing equipment 140, and drawing 5 is the elements on larger scale. A bearing sleeve 103 is fixed to a motor case 120, the thrust supporting plate 105 is fixed and the soffit of a bearing sleeve 103 constitutes the supporter of an axis 101. The thrust plate 102 is being fixed to the soffit of an axis 101, and it is supported free [a revolution] to a bearing sleeve 103 and the thrust supporting plate 105. Here, the peripheral face 107 of an axis 101 and the inner skin 106 of a bearing sleeve 103 constitute the radial bearing section, and the dynamic pressure generating slot is formed at least in one side of the peripheral face 107 of an axis 101, and the inner skin 106 of a bearing sleeve 103.

[0005] Furthermore, the bearing surface 114 of the thrust supporting plate 105 which counters the field 110 of the bearing sleeve 103 which counters the top face 108 of the thrust plate 102, and the underside 109 of the thrust plate 102 constitutes the thrust bearing section, and the dynamic pressure generating slot is formed in the top face 108 and underside 109 of the thrust plate 102. Moreover, the clearance between a fixed part and the revolution section is filled up with the lubrication fluid up to near [clear aperture 115] a clearance. In order to rotate the hydrodynamic bearing equipment of the above structure, the hub 125 was established in the axis 101, the rotor magnet 126 was formed in the hub 125, and the stator 121 is formed in the motor case 120. It sets in said configuration and immobilization with immobilization of an axis 101, the thrust plate 102, and a hub 125, a motor case 120, and a bearing sleeve 103, the thrust supporting plate 105 and a stator 121 is performed by choosing or combining suitably from eye a running fit, adhesion, spot welding, etc.

[0006]

[Problem(s) to be Solved by the Invention] In the conventional hydrodynamic bearing equipment shown in drawing 4 and drawing 5 , in order to generate dynamic pressure, generally it is necessary to manage the clearance between the radial bearing section and the thrust bearing section near 5 micrometer. Furthermore, in order to manage the variation in a product in mass production,

the clearance between bearings of each product needs to be managed in the variation precision which is 1 micrometer - about 2 micrometers. The clearance between the radial bearing sections is managed actually, including [not only the difference of the outer diameter of an axis 101 and the bore of the inner skin 106 of a bearing sleeve 103 but] precision, such as surface roughness of the peripheral face 107 of an axis 101, roundness and cylindricity, the surface roughness of the inner skin 106 of a bearing sleeve 103 and roundness, and cylindricity. Since it is also possible to carry out finish-machining by the others, the grinding process, and polish processing of cutting, such as an engine lathe, the peripheral face 107 of an axis 101 and the inner skin 106 of a bearing sleeve 103 are parts which are easy to manage precision also in mass production.

[0007] Also about the clearance between another thrust-bearing sections, it is managed actually, including [the level difference 112 of a bearing sleeve 103, and not only the difference of the thickness 113 of the thrust plate 105 but] precision, such as flatness of the flatness of the top face 108 of the thrust plate 102, and an underside 109, the flatness of the bearing surface 114 of the thrust supporting plate 105 and the field 110 of a bearing sleeve 103, and a field 111. In it, the thickness 113 of the thrust plate 102, its top face 108, its underside 109, and the bearing surface 114 of the thrust supporting plate 105 are possible for acquiring the precision of components by surfacing processing by the grinding

process or polish processing if needed besides cutting.

[0008] However, since surfacing processing has difficult structure, the field 110 of a bearing sleeve 103 does not attain to the flatness of a grinding process side or a polish processing side at all depending on the precision of cutting, such as an engine lathe. Therefore, the process tolerance of a level difference 112 is [about 5 micrometers of the mass production components process tolerance] also a limitation depending on the precision of cutting, such as an engine lathe. When hydrodynamic bearing equipment is assembled using the bearing sleeve of such a precision, the flatness of a field 110 also influences the precision of a level difference 112, and product dispersion of the clearance between the thrust bearing sections has become 5 micrometers or more. therefore, mass production ---like -- the clearance between the thrust bearing sections -- product dispersion -- 1 micrometer - 2 micrometers -- management -- things are dramatically difficult.

[0009] This invention is for solving said technical problem, and the place made into the object is to offer the hydrodynamic bearing equipment of the structure where the precision of the clearance between the thrust bearing sections is acquired in mass production.

[0010]

[Means for Solving the Problem] With the hydrodynamic bearing equipment of

this invention, in order to attain the above-mentioned object, the level difference structure prepared in the conventional bearing sleeve is abolished, by using a thrust spacer, finish-machining of the grinding process of the thrust bearing side of a bearing sleeve, polish processing, etc. is enabled, and management of the clearance precision of the thrust bearing section is enabled also in mass production. The configuration of the following publication is adopted as the configuration.

[0011] With the hydrodynamic bearing equipment of this invention according to claim 1, the bearing sleeve which has the cylinder-like inner circumference section is fixed to the inner circumference of housing. Or fix to housing the axis which has the cylinder-like periphery section, and the bearing sleeve which has the cylindrical inner circumference section is fitted into the periphery of this axis, enabling a free revolution. The axis which has the cylindrical periphery section is fitted into the inner circumference of this bearing sleeve, enabling a free revolution. In the hydrodynamic bearing equipment which comes to prepare the thrust plate of the outer diameter which consists of a path of the periphery section of an axis size to these some axes, it is characterized by fitting said thrust plate into opposite through a thrust spacer with said bearing sleeve and thrust supporting plate.

[0012] With the hydrodynamic bearing equipment of this invention according to

claim 2, it is characterized by using the ceramics for said thrust spacer in hydrodynamic bearing equipment according to claim 1.

[0013]

[Embodiment of the Invention] The gestalt of operation of this invention is explained using drawing 1 , drawing 2 , and drawing 3 . Drawing 1 is the hydrodynamic bearing equipment 7 of the gestalt of operation of the 1st of this invention, and the sectional view of the motor 8 incorporating it, and drawing 2 is the elements on larger scale. The bearing sleeve 10 which has the cylinder-like inner skin 11 is being fixed to motor case 45 inner circumference 46. Fitting of the revolution of the axis 1 which has the cylindrical peripheral face 2 is made free to the inner skin 11 of a bearing sleeve 10, and the clearance 3 is formed. Radial bearing is formed between the inner skin 11 of a bearing sleeve 10, and the peripheral face 2 of 1 of an axis by preparing a dynamic pressure generating slot pattern in either [at least] the inner skin 11 of a bearing sleeve 10, or the peripheral face 2 of an axis 1.

[0014] Moreover, the thrust plate 20 of the outer diameter which consists of a path of the peripheral face 2 of an axis 1 size is formed in the lower part 4 of an axis 1. The clearance between the thrust bearing sections for fitting in so that an axis 1 may be countered through the thrust spacer 30 at a bearing sleeve 10 and the thrust supporting plate 25, and enabling the revolution of the thrust plate 20

of the thrust plate 20 is formed. Moreover, the thrust bearing section is formed between the thrust plate 20, and a bearing sleeve 10 and the thrust supporting plate 25 by preparing a dynamic pressure generating slot pattern in at least at least one side of the top face 21 of the thrust plate 20, and the underside 12 of a bearing sleeve 10, and one side of the underside 22 of the thrust plate 20, and the top face 26 of the thrust supporting plate 25.

[0015] Furthermore, the lubrication fluid is enclosed with the radial bearing section and the thrust bearing section. The covering 35 for preventing scattering of a lubrication fluid is formed in the top face 13 of a bearing sleeve 10, and it is also possible into the part 36 near the axis 1 of the covering 35 to form labyrinth seal structure and magnetic fluid seal structure. Moreover, since it is the general configuration of the conventional technique previously explained about the rolling mechanism of a motor using drawing 4 , explanation is omitted here.

[0016] Next, clearance management of bearing is explained. Since clearance management of the radial bearing section is the same as usual, it is omitted, and clearance management of the thrust bearing section which is the description of this invention is explained here. The clearance between the thrust bearing sections is managed actually, including [not only the difference of the thickness 23 of the thrust plate 20, and the thickness 33 of the thrust spacer 30 but] precision, such as the parallelism of the top face 21 of the thrust plate 20, and an

underside 22 and each flatness, flatness of the top face 26 of the thrust supporting plate 25 and flatness of the underside 12 of a bearing sleeve 10, parallelism of the top face 31 of the thrust spacer 30, and an underside 32, and each flatness.

[0017] Although the thickness 23 of the thrust plate 20, its top face 21, its underside 22, and the top face 26 of the thrust supporting plate 25 can acquire the precision of components by surfacing processing by the grinding process or polish processing as usual if needed besides cutting Furthermore, by having abolished the level difference structure prepared in the conventional bearing sleeve in this invention, and having formed the thrust spacer 30 for clearance management Surfacing processing by the grinding process or polish processing is possible also to the underside 12 of a bearing sleeve 10, and the top face 31 and underside 32 of the thrust spacer 30. Therefore, it has structure in which surfacing processing is possible on all the member front faces in connection with management of the clearance between the thrust bearing sections.

[0018] Although it is possible to choose it from a metal and an alloy, the ceramics, glass, plastics, etc. as each part article which constitutes hydrodynamic bearing equipment 7 suitably, and to use for it, there is little elastic deformation at the time of processing, and to the heat generated during processing, the small construction material of a dimensional change is desirable

into the part which acquires dimensional accuracy, and brittle materials, such as ceramics and glass, are mentioned to it by a grinding process and polish processing as the ingredient. It is still more desirable to use the ceramics with high reinforcement also in it. As construction material of the ceramics, it is possible to use an alumina, a zirconia, silicon nitride, silicon carbide, etc. however, since it leads to a cost rise, if the ceramics is used for a bearing sleeve 10 and the thrust spacer 30 and surfacing processing is performed also in it, as compared with the conventional bearing sleeve 103, it will boil using the ceramics for all members markedly, and its dimensional accuracy will improve.

[0019] Furthermore, using the ceramics for the thrust spacer 30 also especially in it has the largest effectiveness, and the process tolerance of the thickness 33 is clear from being the part compared with the cutting precision of the level difference 112 of the conventional bearing sleeve 103. Although 5 micrometers is a limitation in [the cutting precision of a level difference 112] mass production, when polish processing is performed on the top face 31 and underside 32 of the thrust spacer 30 made from the ceramics, specifically, the dimensional accuracy of the thickness 33 can be managed to 1 micrometer or less also in mass production.

[0020] The hydrodynamic bearing equipment 7 of this invention was assembled, and product dispersion of the clearance between the thrust bearing sections was

measured. In addition, with the clearance between the thrust bearing sections, since it not the difference of the thickness 33 of the thrust spacer 30, and the thickness 23 of the thrust plate 20 but was influenced of the front face of the member which constitutes the clearance between the thrust bearing sections as mentioned above, the thrust plate only made the movable range the clearance between the thrust bearing sections actual up and down. The measurement measured and searched for the difference of the height of the field 6 of an axis 1 of the case where the thrust plate 20 which fitted into the axis 1 is pushed against the top face 26 of the thrust supporting plate 25, and the case where it pushes against the underside 12 of a bearing sleeve 10. The design value of the clearance between the thrust bearing sections was set to 10.0 micrometers.

[0021] First, stainless steel was used for the bearing sleeve 10, the thrust supporting plate 25, the thrust plate 20, and the thrust spacer 30, polish processing was performed on the underside 12 of a bearing sleeve 10, the top face 26 of the thrust supporting plate 25, the top face 21 of the thrust plate 20, an underside 22 and the top face 31 of the thrust spacer 30, and the underside 32, the thickness 33 of the thrust spacer 30 was used by 1 micrometer or less in the maximum minimum range, and 20 hydrodynamic bearing equipments 7 of this invention were assembled. When the clearance between the thrust bearing sections was measured, it was 0.8 micrometers in the average of 10.5

micrometers, and standard deviation. Next, the ceramics was used for the thrust spacer 30, the maximum minimum range of the thickness 33 was managed to 0.5 micrometers or less, and 20 hydrodynamic bearing equipments 7 of this invention were assembled. When the clearance between the thrust bearing sections was measured, it was 0.3 micrometers in the average of 10.1 micrometers, and standard deviation.

[0022] As mentioned above, the direction used from the gestalt of operation of the 1st of this invention combining a bearing sleeve 20 and the thrust spacer 30 Since the structure of each part article is conventionally simplified rather than the bearing sleeve 103 of structure, the grinding process to the underside 12 of a bearing sleeve 10, the top face 31 of the thrust spacer 30, and an underside 32 and processing of surfacing called polishing processing were attained, and became possible [boiling markedly dispersion in each product of the clearance between the thrust bearing sections, and making it small]. Moreover, if the ceramics is used for a thrust spacer and the thickness precision of a thrust spacer is raised, clearance dispersion of the thrust bearing section after assembly can also be made smaller.

[0023] Drawing 3 is the hydrodynamic bearing equipment 57 of the gestalt of operation of the 2nd of this invention, and the sectional view of the motor 58 incorporating it. The gestalt of the 1st operation is a type which a shaft rotates,

and the gestalt of the 2nd operation is a type which a bearing sleeve rotates. The conventional level difference structure of a bearing sleeve is abolished, the description using a thrust spacer is the same as the gestalt of the 1st operation, and since the precision as the gestalt of the 1st operation with the same dispersion range of the clearance between the thrust bearing sections is acquired, the following explains only the structure of hydrodynamic bearing equipment 57. The axis 50 is being fixed to the motor case 95. A clearance 52 is formed in the periphery of an axis 50, fitting of the revolution of a bearing sleeve 60 is made free to it, and the hub 90 is being fixed to the periphery of a bearing sleeve 60.

[0024] Furthermore, the thrust plate 70 of the outer diameter which consists of the path size is formed in the axis 50. The clearance between the thrust bearing sections for fitting in so that an axis 50 may be countered through the thrust spacer 80 at a bearing sleeve 60 and the thrust supporting plate 75, and enabling the revolution of the thrust plate 70 of the thrust plate 70 is formed. The radial bearing section is formed between the inner skin 61 of a bearing sleeve 60, and the peripheral face 51 of 50 of an axis by preparing a dynamic pressure generating slot pattern in either [at least] the inner skin 61 of a bearing sleeve 60, or the peripheral face 51 of an axis 50.

[0025] Moreover, the thrust bearing section is formed between the thrust plate

70, and a bearing sleeve 60 and the thrust supporting plate 75 by preparing a dynamic pressure generating slot pattern in at least at least one side of the underside 71 of the thrust plate 70, and the top face 62 of a bearing sleeve 60, and one side of the top face 72 of the thrust plate 70, and the underside 76 of the thrust supporting plate 75. Moreover, the lubrication fluid is enclosed with the radial bearing section and the thrust bearing section. The covering 85 for preventing scattering of a lubrication fluid is formed in the underside 63 of a bearing sleeve 60. About the rolling mechanism of a motor, it is possible to apply the general configuration of ** like the conventional technique which drawing 4 used previously and was explained.

[0026]

[Effect of the Invention] According to the structure of the hydrodynamic bearing equipment of this invention according to claim 1, so that clearly from the gestalt of the above operation The direction used combining two components of a bearing sleeve and a thrust spacer The structure of components was simplified, since processing of surfacing, such as a grinding process and polish processing, was attained, the process tolerance of components improved, and it became possible to suppress small dispersion in the product of the clearance between the thrust bearing sections from bearing-sleeve 1 components which need stage processing like structure before.

[0027] Moreover, while according to the hydrodynamic bearing equipment of this invention of claim 2 there was little elastic deformation at the time of processing and it was possible to have raised the process tolerance of a thrust spacer further by using the small ceramics of a dimensional change for a thrust spacer to the heat generated during processing, it became possible to suppress still smaller product dispersion of the clearance between the thrust bearing sections.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Type section drawing showing the motor incorporating the hydrodynamic bearing equipment of this invention.

[Drawing 2] The elements on larger scale of type section drawing showing the motor incorporating the hydrodynamic bearing equipment of this invention.

[Drawing 3] Type section drawing showing the motor incorporating the hydrodynamic bearing equipment of this invention.

[Drawing 4] Type section drawing showing the motor incorporating conventional hydrodynamic bearing equipment.

[Drawing 5] The elements on larger scale of type section drawing showing the

motor incorporating conventional hydrodynamic bearing equipment.

[Description of Notations]

1 50 Axis

2 51 Peripheral face

3 52 Clearance

4 Lower Part

6 Field

7 57 Hydrodynamic bearing equipment

8 58 Motor

10 60 Bearing sleeve

11 61 Inner skin

12, 22, 32, 63, 71, 76 Underside

13, 21, 26, 31, 62, 72 Top face

20 70 Thrust plate

23 33 Thickness

25 75 Thrust supporting plate

30 80 Thrust spacer

35 85 Covering

36 Part

45 95 Motor case

46 Inner Circumference

90 Hub